Circuit 2
Second

ENGINEERING	التخصص والمستوى :	السلطة الوطنية الفلسطينية
Electric circuits2	اسم المساق :	جامعة فلسطين التقنية طولكرم"خضوري"
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90 m	زمن الامتحان :	

العلامة $\frac{21}{30}$

21

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الشعبة : اثنين اربعاء 8:00-9:30

[redacted]

Q1)For the system shown below

a)Find the total average power, the total reactive power , total apparent power & the power factor of the system (4)

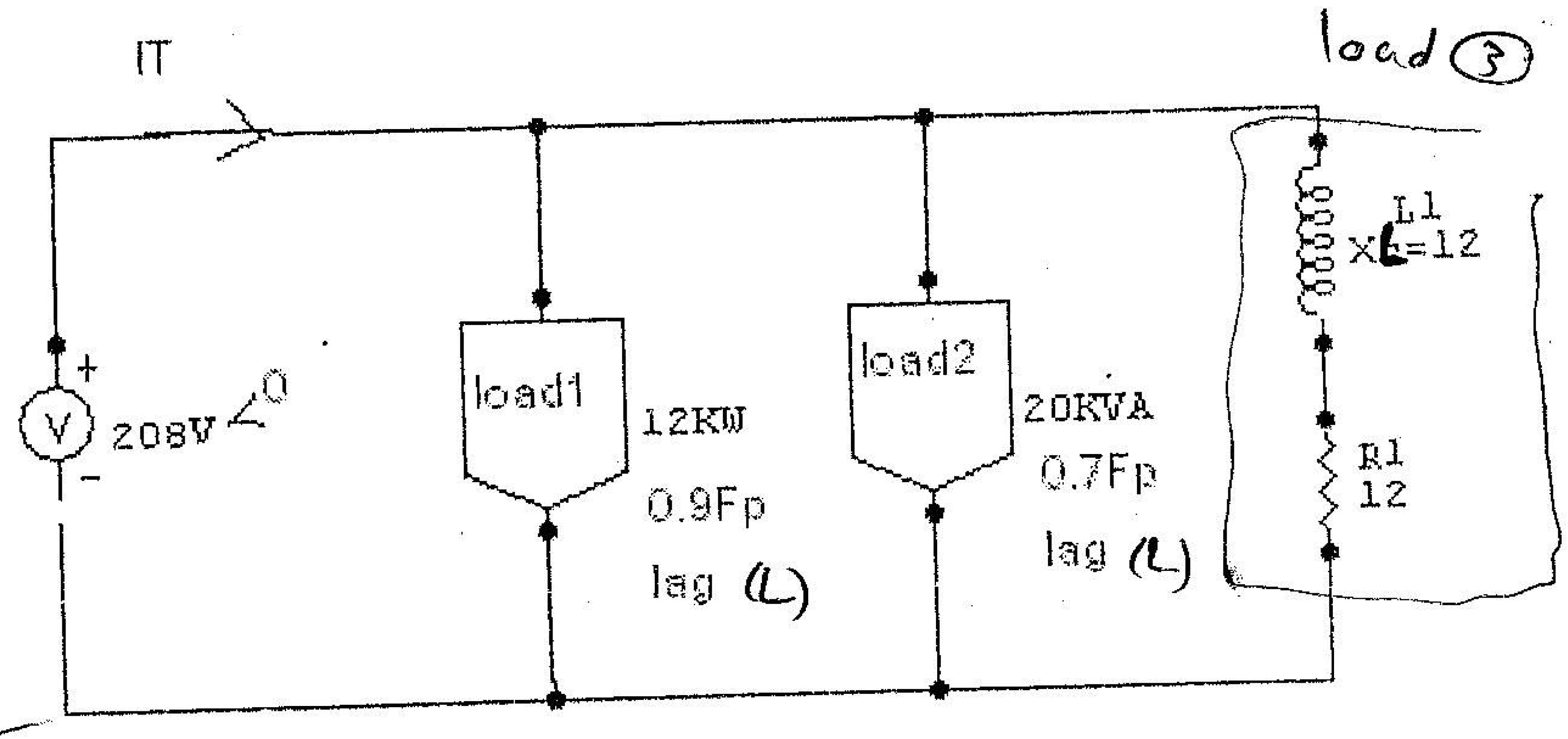
b)Sketch the power triangle of the system (1)

c)Find the total supply current I_T (1)

d)Determine the value of the capacitor that must be added in parallel of these loads to raise the power factor of the system to 0.95 if the frequency of the system is 60 Hz (3)

e)Determine the total supply current after this correction (1)

7½



a) load 1

$\boxed{P_1 = 12KW}$

$F_p = 0.9 = \cos^{-1}(\theta)$

$\boxed{\theta = 25.8^\circ}$

$F_p = \frac{P_1}{S_1}$

$S_1 = \frac{P_1}{F_p} = \frac{12\ kW}{0.9} = \boxed{13.3\ KVA}$

$\therefore Q_1 = S \sin\theta = 13.3 \sin(25.8^\circ) = \boxed{5.78\ KVAR}$

1

load 2

$S_2 = 20\ KVA$

$F_p = 0.7 = \cos^{-1}(\theta)$

$\boxed{\therefore \theta = 45.5^\circ}$

but $F_p = \frac{P_2}{S_2} \Rightarrow 0.7 = \frac{P_2}{20} \Rightarrow \boxed{P_2 = 14\ kW}$

$Q_2 = S_2 \sin\theta = 20 \sin 45.5^\circ = \boxed{14.26\ KVAR}$

1

تم الرفع بواسطة
م.معن البوعيسى

load 3 $\quad P_3 = \frac{V^2}{R} = \frac{(208)^2}{12} = \boxed{3.6\ kW}$

$Q_3 = \frac{V^2}{X_L} = \frac{(208)^2}{12} = \boxed{3.6\ KVAR}$

$\therefore S_3 = \sqrt{(3.6)^2 + (3.6)^2} = \boxed{5.1\ KVA}$

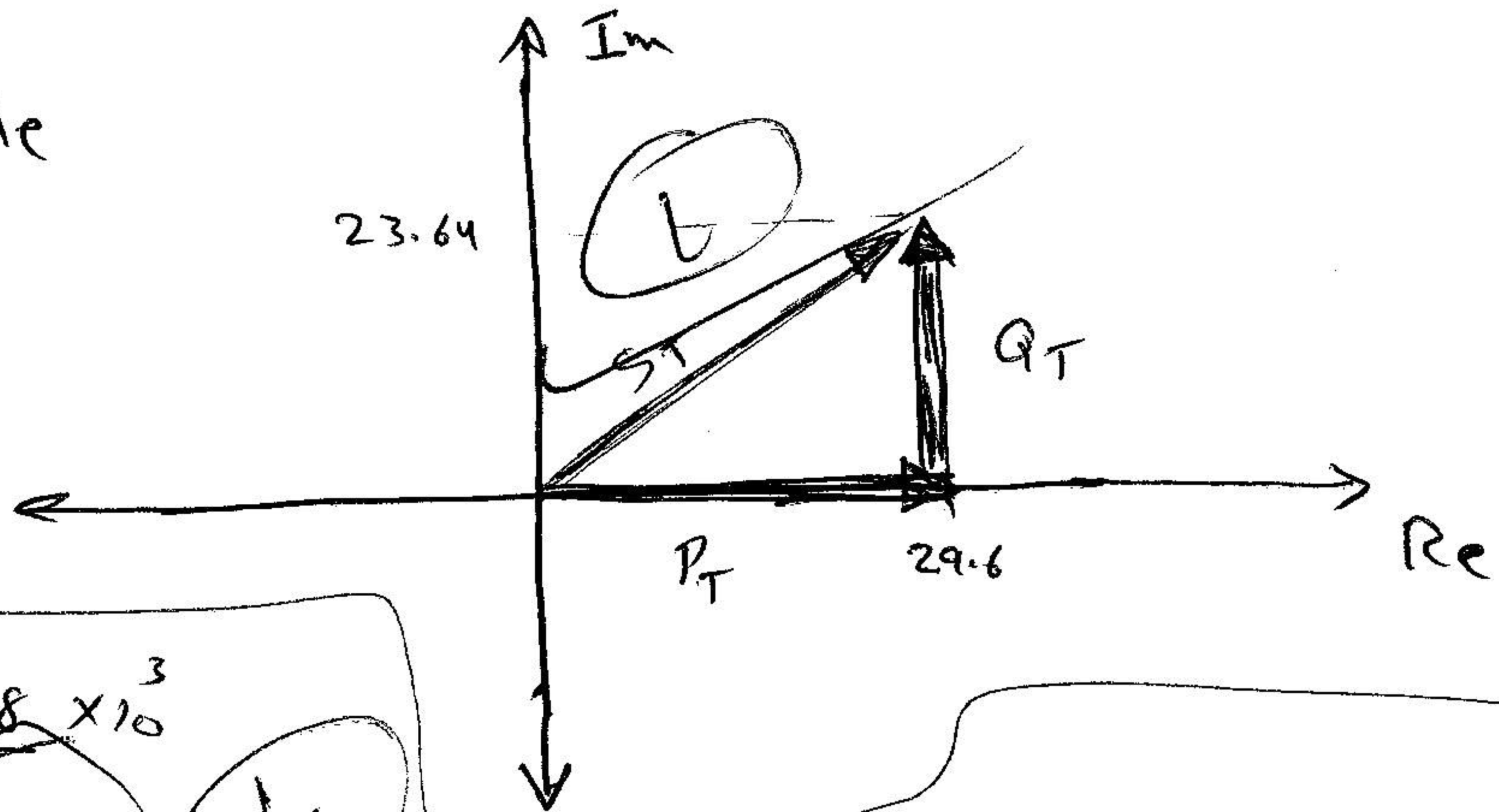
يتبع

$P_T = P_1 + P_2 + P_3 = 12 + 14 + 3.6 = \boxed{29.6 \text{ kW}}$

$Q_T = Q_1 + Q_2 + Q_3$ (inductive) $= 5.78 + 14.26 + 3.6 = \boxed{23.64 \text{ KVAR}}$

$S_T = \sqrt{P_T^2 + Q_T^2} = \sqrt{(29.6)^2 + (23.64)^2} = \boxed{37.88 \text{ KVA}}$

b The Power Triangle



c $I_T = \dfrac{S_T}{V} = \dfrac{37.88 \times 10^3}{208}$

$= \boxed{182.1 \text{ A}}$

d $F_p = 0.95 \Rightarrow \theta = \cos^{-1}(0.95) = \boxed{18.19^\circ}$

$P_T = 29.6 \text{ kW}$

$F_p = \dfrac{P_T}{S_T} \Rightarrow 0.95 = \dfrac{29.6 \text{ kW}}{S_T} \Rightarrow S_T = \dfrac{29.6 \text{ kW}}{0.95} = \boxed{31.15 \text{ KVA}}$

$\therefore Q_T = S \sin(18.19^\circ) = (31.15)\sin(18.19^\circ) = \boxed{9.72 \text{ KVA}}$

$\therefore$ The Reactive Power that must be added to raise the power factor is $23.64 - 9.72 = \boxed{13.92 \text{ KVAR}}$

$\therefore Q_4 = 13.92 \text{ KVAR} = \dfrac{V^2}{X_c} \Rightarrow 13.92 = \dfrac{(208)^2}{X_c}$

$\therefore X_c = \dfrac{(208)^2}{13.92 \text{ KVAR}} = \boxed{3.1\ \Omega}$

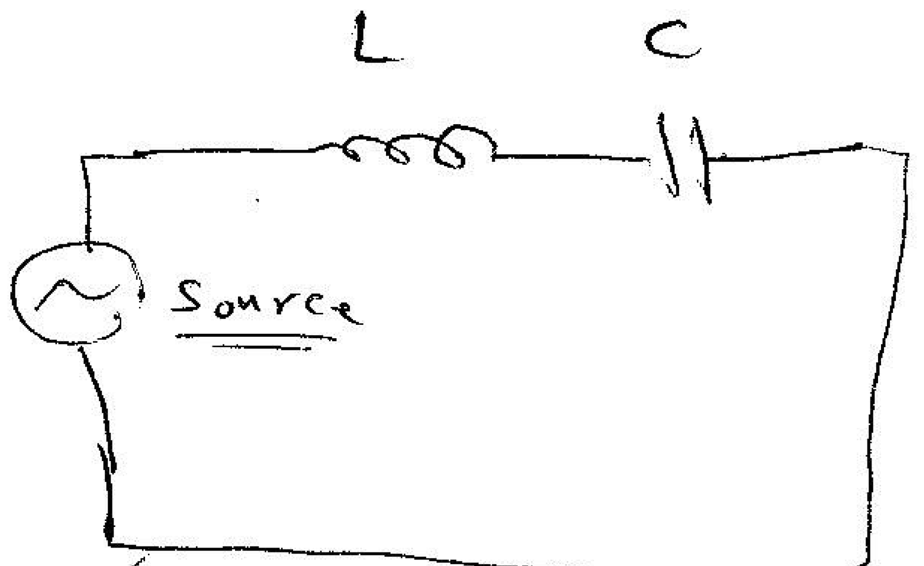
$X_c = \dfrac{1}{wC} \Rightarrow C = \dfrac{1}{w X_c} = \dfrac{1}{2\pi f X_c} = \dfrac{1}{2\pi \times 60 \times 3.1} =$

$8.5 \times 10^{-4} \text{ F} = \boxed{0.85 \text{ mF}}$

e $I_{T \text{ after}} = \dfrac{S_T}{V} = \dfrac{31.15 \text{ kVA}}{208} = \boxed{149.7 \text{ A}}$

Q2)Design a series resonance circuit to have a BW of 400Hz using a coil with a $Q_L=20$ & $R_L=2\Omega$.
Find the values of L, C, f_s & the cutoff frequencies (5)

$\boxed{BW} = 400\ Hz$



$$BW = \frac{f_s}{Q_s} = \frac{R}{2\pi L} = \frac{R_L}{2\pi L} = \frac{2}{2\pi L}$$

6

$$400 = \frac{2}{2\pi L} \Rightarrow \boxed{L} = \frac{2}{2\pi(400)}$$

$$= 7.95\times10^{-4} \approx \boxed{0.8\ mH}$$

here $Q_L = 20 > 10$

$\therefore Q_L = Q_s$

$$\therefore BW = \frac{f_s}{Q_s} \Rightarrow 400 = \frac{f_s}{20} \Rightarrow \boxed{f_s} = 8000 = \boxed{8\ kHz}$$

$$\boxed{f_s} = \frac{1}{2\pi\sqrt{LC}} \Rightarrow 8000 = \frac{1}{2\pi\sqrt{0.8\times10^{-3}\,C}}$$

$$\Rightarrow 16000\pi = \frac{1}{\sqrt{0.8\times10^{-3}\,C}} \Rightarrow 16000\pi = \frac{1}{\sqrt{0.0008C}}$$

$$\sqrt{0.0008C} = \frac{1}{16000\pi} \Rightarrow \sqrt{0.0008C} = 1.98\times10^{-5}$$

$$0.0008C = (1.98\times10^{-5})^2 \Rightarrow 0.0008C = 3.92\times10^{-10}$$

$$\Rightarrow \boxed{\therefore C} = \frac{3.92\times10^{-10}}{0.0008} = 4.9\times10^{-7} = \boxed{0.49\ \mu F}$$

$$\boxed{f_1} = f_s - \frac{BW}{2} = 8000 - \frac{400}{2} = \boxed{7800\ Hz}$$

$$\boxed{f_2} = f_s + \frac{BW}{2} = 8000 + \frac{400}{2} = \boxed{8200\ Hz}$$

Q3)For the network below

a)Find the value of X_L for resonance (1)

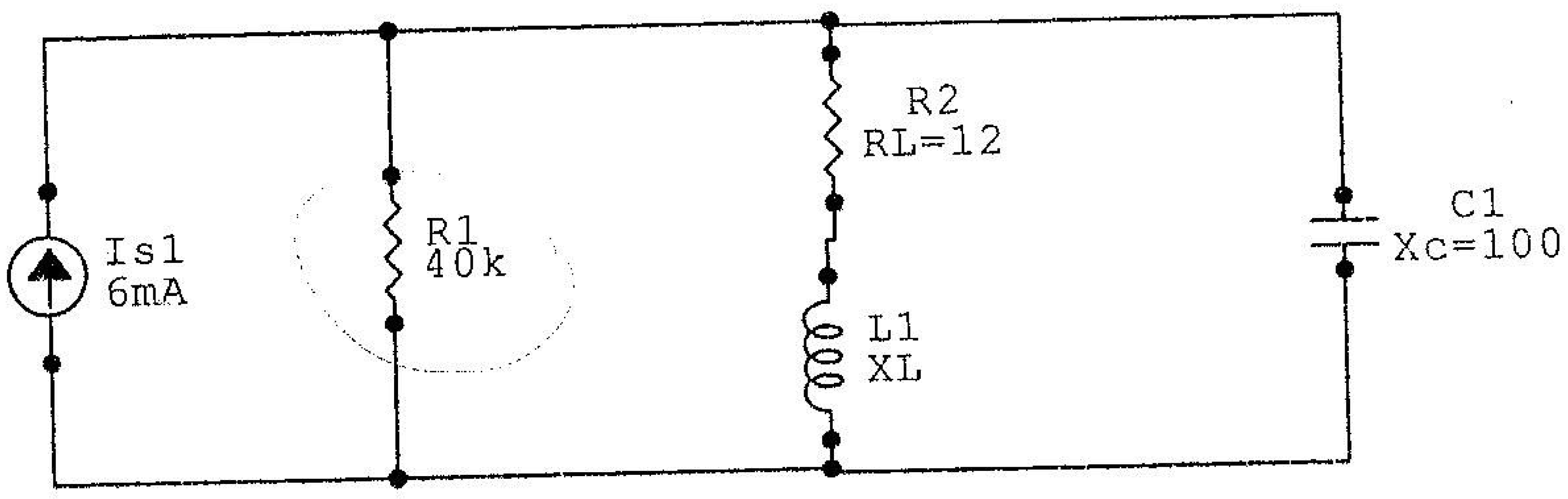
b)Find the value of Q_L (1)

c)Find the resonance frequency if the BW is 1KHz (1.5)

d)Find the maximum value of the voltage Vc (1.5)

e)Sketch the curve of Vc versus frequency indicating its peak value ,resonance frequency and half power frequencies (2)

f)Find the values of I_L & Ic at resonance (1)



a at resonance $\Rightarrow X_L = X_C \Rightarrow \boxed{X_L = 100\,\Omega}$ (1)

$X_{Lp} = \dfrac{R_L^2 + X_L^2}{X_L} = \dfrac{(12)^2 + (100)^2}{100} = \dfrac{144 + 10000}{100} = \boxed{101.44\,\Omega}$

$R_p = \dfrac{X_L^2 + R_L^2}{R_L} = \dfrac{(100)^2 + (12)^2}{12} = \boxed{845.33\,\Omega}$

$Q_p = \dfrac{R}{X_{Lp}} = \dfrac{R_s \parallel R_p}{X_{Lp}}$

$R_s \parallel R_p = \dfrac{40(0.845)}{40 + 0.845} = \boxed{0.828\,k\Omega} = \boxed{828\,\Omega}$

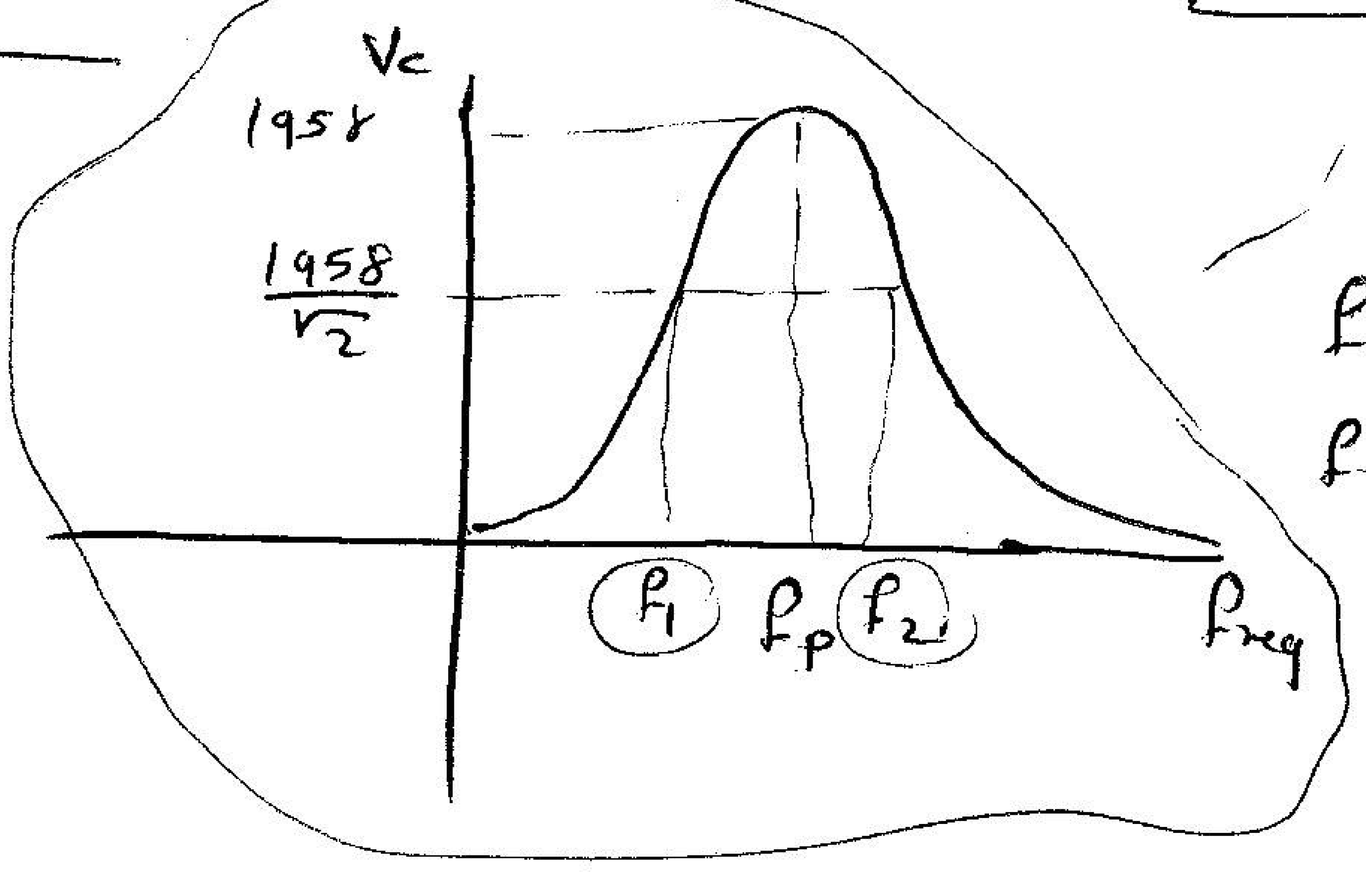
b $Q_p = \dfrac{R}{X_{LP}} = \dfrac{828}{101.44} = \boxed{8.16} = \boxed{Q_L}$ (1)

c $BW = 1000\,Hz = \dfrac{f_p}{Q_p} \Rightarrow 1000 = \dfrac{f_p}{8.16} \Rightarrow \boxed{f_p = 8.16\,kHz}$

d $V_C = V_L = Q_p E \Rightarrow \boxed{V_s = 6\times10^{-3} \times 40\times10^{3} = 240\,V}$

$\therefore V_C = Q_p E = 8.16 \times 240 = \boxed{1958\,V}$

e graph



$f_1 = f_p - \dfrac{BW}{2} = 8.16 - \dfrac{1}{2} = 7.66\,kHz$

$f_2 = f_p + \dfrac{BW}{2} = 8.16 + \dfrac{1}{2} = 8.66\,kHz$

Page 4

(f) :

I_c & I_L

at resonance $\Rightarrow$ $X_c = X_L \Rightarrow \frac{V}{X_c} = \frac{V}{X_L}$

$\Rightarrow I_c = I_L$

Q4)For the Y-Δ connected system below . If the phase sequence of the generator is ACB and $E_{AB}=220\angle 0$

a) What is the magnitude and phase angle of E_{BC} , E_{CA} (1)

b) What is the magnitude and phase angle of E_{AN} , E_{BN} , E_{CN} (1.5)

c) What is the magnitude and phase angle of I_{ab}, I_{bc}, I_{ca} (3)

d) What is the magnitude and phase angle of I_{Aa}, I_{Bb} , I_{Cc} (1.5)

In Y

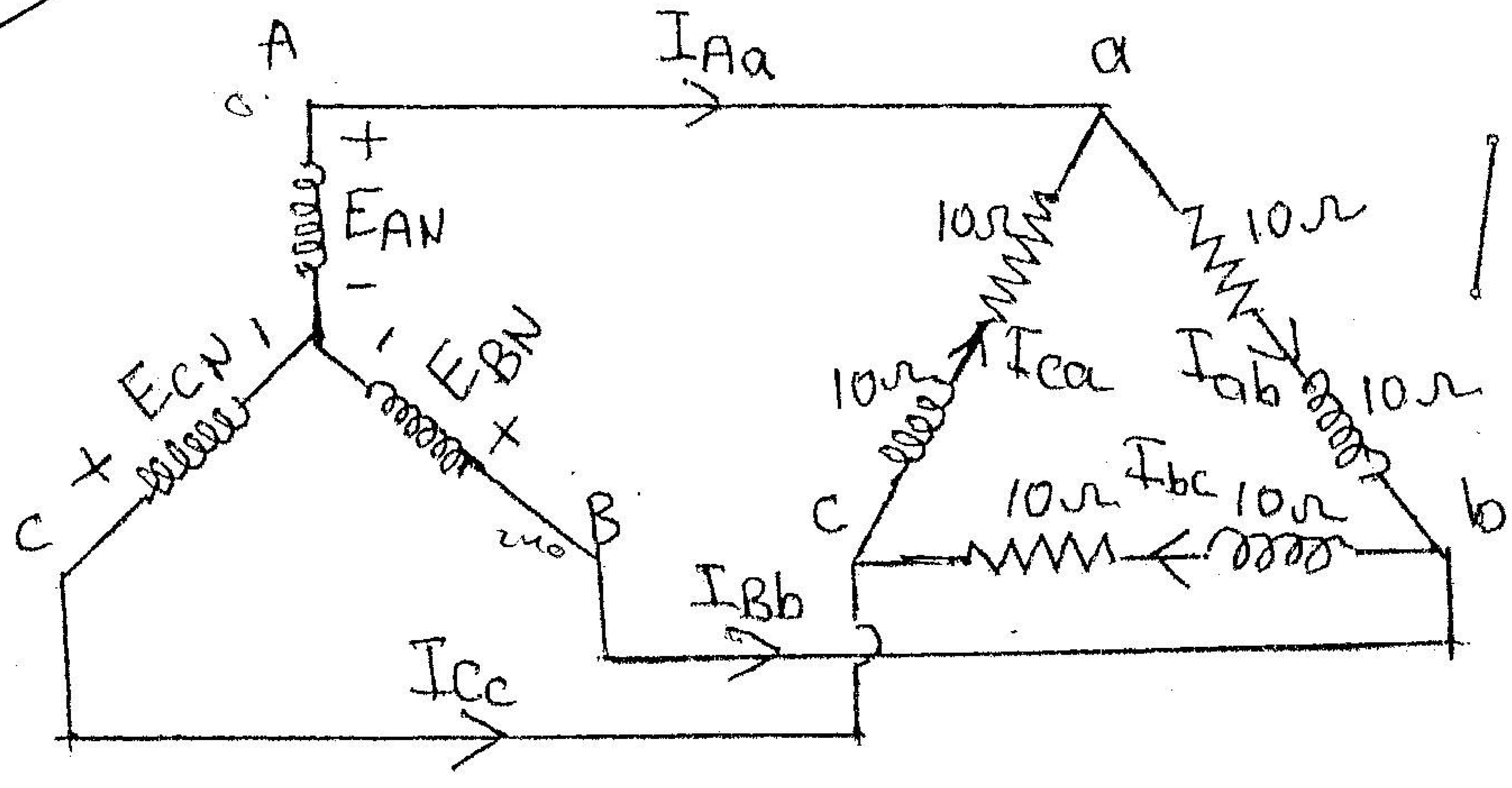
$I_L = I_\phi$

$V_L = \sqrt{3}\, V_\phi \quad +\angle 30^\circ$

In Δ

$V_L = V_\phi$

$I_L = \sqrt{3}\, I_\phi \quad -\angle 30^\circ$



(a) $E_{AB} = 220 \angle 0^\circ$

$E_{BC} = 220 \angle 240^\circ$

$E_{CA} = 220 \angle -120^\circ$

(b) $E_{AN} = \frac{220}{\sqrt{3}} \angle -30^\circ = 127 \angle -30^\circ$

$E_{BN} = \frac{220}{\sqrt{3}} \angle -270^\circ = 127 \angle -270^\circ$

$E_{CN} = \frac{220}{\sqrt{3}} \angle -150^\circ = 127 \angle -150^\circ$

(c) here , $V_L = V_\phi \Rightarrow V_L = 220\ V$

$I_{ab} = \frac{220 \angle 0^\circ}{10 + j10} = \frac{220 \angle 0^\circ}{14.1 \angle 45^\circ} = \boxed{15.6 \angle 45^\circ \quad A}$

$I_{bc} = 15.6 \angle -105^\circ$

$I_{ca} = 15.6 \angle -75^\circ$

(d) $I_{Aa} = \sqrt{3}\, I_\phi = \sqrt{3}\; 15.6 \angle 0^\circ = 27 \angle 0^\circ$

$I_{Bb} = 27 \angle +30^\circ$

$I_{Cc} = 27 \angle 30^\circ$

Good Luck
Mahmoud Ahmad